Remarks

Claims 1-15, 17-21, and 24-36 remain in the application.

The Examiner has rejected Claim 24 under 35 U.S.C. §112, ¶2 because of lack of antecedent basis. The Examiner also objects to Claim 24 as placing the period in the wrong position. Claim 24 has been amended to remove material erroneously entered in the Response to the Restriction Requirement without notice of its entry. Its present form avoids the objected informalities and follows that of the filed application except for corrections of editorial problems and self-consistency.

The Examiner has rejected Claims 1, 3, 5, 6, 7, 24, and 27-29 under 35 U.S.C. §103(a) as being obvious over Tsuyama et al. (U.S. Patent Application Publication 2002/0015551 A1, hereafter Tsuyama). This rejection is traversed. Tsuyama concentrates at the circuit level with few references to the structure of the components. The Examiner admits that Tsuyama does not explicitly teach that the electronic circuitry and waveguides are formed in a substrate, but he nonetheless concludes that such is either inherent or is obvious. It is pointed out that Claim 1 requires all the elements to be at least partially formed in a single substrate. The language of being formed in a substrate does not cover a chip bonded to a carrier since the waveguide or circuitry is formed over the carrier and not formed in the carrier. Admittedly, Tsuyama forms his arrayed waveguide gratings (AWGs) in respective substrates, but he fails to disclose that they are formed in a single common substrate. Indeed, in FIG.9 Tsuyama shows his demultiplexers 171 separated from his mux/demultiplexers 53 by his wavelength conversions sections 51. Tsuyama described the structure of the variable wavelength section 51 in ¶¶116 – 124. Tsuyama includes no statement that the wavelength converters are integrated on the same substrate as the two AWGs. In fact, the described wavelength converters rely upon some unstated type of electrical modulation of the Mach-Zehnder interferometer. The related and cited U.S. Patent 6,522,803 to Nakajima et al. shows a thermal not electronic modulation of a Mach-Zehnder in FIG. 6.

Claim 1 has been amended to require that the wavelength conversion be performed while

retaining the signal in optical form. In contrast, Tsuyama requires conversion of the optical signal to electrical form during the conversion process. As Tsuyama describes in ¶118 with reference to FIG. 5A, the O/E (presumably optical-electronic converter) 91 photoelectrically converts the input optical signal into an electrical signal, which is thereafter applied to a Mach-Zehnder modulator 93 to modulate the output of a photodiode 92. Clearly, Tsuyama does not maintain the input optical signal in optical form during wavelength conversion, contrary to amended Claim 1.

However, a new independent Claim 32 substantially replicates the unamended Claim 1 and does not require the all-optical wavelength conversion but still requires the novel single substrate.

New Claims 30 and 31 depend upon Claim 1 and recite features of the wavelength conversion that make the invention advantageous when used as a router. The time limitation is supported at page line 16, when read in the context of the remaining description of a router. In contrast, the circuitry of Tsuyama is apparently a fixed channel switch, not a router. Claim 31 specifies one type of router dependent upon addressing contained in the packet, contrary to the external control of Tsuyama.

Claim 24 similarly has the limitation that the first, second, and third arrayed waveguide gratings be formed in one substrate. Similarly to the arguments presented above, Tsuyama concentrates at the circuit level with no disclosure of the different parts of his network of FIG.2 being formed in a single first substrate. Furthermore, Tsuyama discloses in ¶¶96-98 his arrayed waveguide grating 70 as a mux/dmux section, that is, the wavelength router 53 of FIG. 2. He does not disclose his 1×p switches 52 (corresponding in function to the claimed first array waveguide gratings) as AWGs. In ¶107 he further maintains the distinction between the two types of elements. Accordingly, Tsuyama fails to suggest the claimed two stages of AWGs.

Yet further, Claim 24 requires plural electrical control circuitries to be bonded in respective sectors of the first substrate. In contrast, Tsuyama shows in FIG. 6 a single control circuit 159. Tsuyama's description of the control circuit 159 in ¶¶156, 160, 161, 165 and 166 gives no suggestion that it be divided in parts or be bonded to different sectors of a substrate. Accordingly, Claim 24 is additionally allowable.

Claim 27 has been amended to incorporate the restrictions of Claim 28 and also to require *W* to be plural, which was explicit previously in the use of the terms multiplexers and demultiplexers. Again, Tsuyama fails to teach forming the three sets of arrayed waveguide gratings in a single substrate.

The Examiner has rejected Claims 1, 3, 24, and 27-29 under 35 U.S.C. §103(a) as being obvious over Nakajima (U.S. Patent 6,522,803) in view of Doerr (U.S. Patent 6,549,313) and Tsuyama. Nakajima describes much of the same network architecture as Tsuyama, and in fact there is substantial overlap of inventors between the two references. However, Nakajima is similarly silent on the structure of most of his circuit elements. The best explained is the Mach-Zehnder interferometer of FIGS. 6A and 6B, which however uses electrical control of heaters to thermally switch outputs, certainly not an effect useful for packet routers for those claims requiring such. More specifically, Claim 3 has been amended to require electronic, not electrical, control of the Mach-Zehnder interferometer, which had previously included the requirement for an active region. Claim 24 more obliquely requires an electronic control circuit connected to a control electrode.

The Examiner references FIG. 17 for arrayed waveguide gratings ("Demultiplexers"). Nakajima describes this embodiment in column 13, ll. 30-67. Nowhere does he mention arrayed waveguide gratings for his demultiplexer. More importantly, contrary to the Examiner's inference, Nakajima does not describe plural electronic circuitries arranged in sectors. The Examiner is apparently attempting to include Nakajima's optical couplers 111, 114 as part of opto-electronic circuitries, but electrical circuitries are being claimed. As should be clear Nakajima's description descriptions of FIGS. 14-16, his control portion receives light, detects it, electrically processes it, and accordingly modulates the output light. Nakajima's optical couplers 111, 114 in contrast appear to be only optical devices, such as a fiber Nakajima's optical couplers 111, 114 in contrast appear to be only optical devices, such as a fiber Yjunction. That is, the electrical and control processing is restricted to the single electrical portion 100 located away from the sectors of the respective demultiplexers. Nakajima does not cure the remaining deficiencies of Tsuyama.

Doerr describes an electronic cross-bar switch, which however uses a wavelength router

similar to that of Tsuyama and Nakajima in combination with tunable lasers providing source radiation for the data modulated modulators 103. Doerr is silent on integration of his various elements, but the free-space and three-dimensional structures shown in FIGS. 4, 7B, 9A, 10B, and 11 indicate that he does not contemplate integration of different elements on a substrate.

Accordingly, none of the references teaches the integration of multiple arrayed waveguides on a single substrate, as required in Claims 1 and 24 and amended Claim 27. None teaches plural electronic control circuits on a second substrate bonded to the first substrate, as required in Claim 24. None teaches all-optical wavelength conversion as required in amended Claim 1 and new Claim 31. Accordingly, all these claims should be held allowable.

The Examiner has rejected Claim 4 under 35 U.S.C. §103(a) as being obvious over Tsuyama in view of Koga (U.S. Patent 5,617,234). Admittedly, Koga teaches a Peltier cooler 22. However, as illustrated in FIG. 4, only a single arrayed waveguide circuit 12 is mounted on the cooler 22. Koga's optical coupler 11 is set off to the side of the cooler 22. Koga therefore does not teach mounting a substrate containing a plurality of arrayed waveguide grating arranged in series on a single cooler. Tsuyama teaches nothing about thermoelectric coolers. Accordingly, the art fails to teach the claimed limitation. Additionally, this claim depends from a claim believed to be in allowable form and should therefore also be allowable.

The Examiner has rejected Claims 2, 25, and 26 under 35 U.S.C. §103(a) as being obvious over Tsuyama in view of Zirngibl (U.S. Patent 5,600,742). Claim 2 depends from a claim believed to be in allowable form and should therefore also be allowable. The features of Claim 25 are not suggested by Zirngibl so this claim is additionally allowable. This claim requires the first substrate including the arrayed waveguide gratings be formed of a InP base while the second substrates including the electronic control circuitry be formed of GaAs bases. (Note that the claim has been amended to provide more consistent antecedent basis.) While Zirngibl allows either InP or GaAs bases for his arrayed waveguide gratings, he does not suggest implementing electronics in a different base material than for his AWG. Claim 26 is yet further allowable since no art has been cited for a electronic silicon circuit in combination with an InP AWG base and GaAs electronics bases.

A new set of Claims 34 and 35 recite the integrated structure of AWGs formed in a InP

base, electronic circuitry in a GaAs base, and control circuitry in a Si base.

The Examiner indicates that Claims 8-11 are allowable. A new dependent Claim 36 corresponds to allowed Claim 9 but depends directly from the base claim.

An Information Disclosure Statement is submitted herewith for newly cited art.

In view of the above amendments and remarks, reconsideration and allowance of all claims are respectfully requested. If the Examiner believes that a telephone interview would be helpful, he is invited to contact the undersigned attorney at the listed telephone number, which is on California time.

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